Full Nearshore Data 2013 - 2017 (CPUE)

Alex J. Benecke

January 30, 2018

All Nearshore Data with Effort

So I want to calculate CPUE for each site and year and species (Although I'm Mainly interested in largemouth bass Species code = 317). I went through the data sheets for 2013 and entered weights so I will also want to use this data file for the Wr analysis. I am excluding year 2017 because it was sampled with a different crew different gear and posibly different methods (Data looks like nothing I've seen in previous years so i just don't trust it).

CPUE by Species and Year

Load Bio and Effort Data

```
bio1 <- read.csv("Data/Raw-Data/Nearshore-Biodat_2013-2017.csv")%>%
  filterD(Year<2017)
```

```
eff1 <- read.csv("Data/Raw-Data/Effort-Nearshore_2013-2017.csv") %>%
  arrange(Year,Site) %>%
  filterD(!is.na(STARTTIME)) %>%
  filterD(Year<2017)
```

Create Effort Variable (Hours Electrofishing)

```
### create Effort variable (Seconds)
eff1$effort.s <- eff1$ENDTIME-eff1$STARTTIME
eff1$effort.min <- (eff1$effort.s)/60
eff1$effort.hr <- (eff1$effort.min)/60

### Using efishing Hours
eff <- eff1 %>% group_by(Year,Site) %>%
  summarize(effort = sum(effort.hr))

#str(eff)
headtail(eff)
```

```
##    Year Site    effort
## 1  2013    2 0.2536111
## 2  2013    4 0.2930556
## 3  2013    6 0.2122222
## 40 2016   15 0.4813889
## 41 2016   18 0.3444444
## 42 2016   19 0.2322222
```

Note:

There is no effort data for Sites 11 and 12 during 2013.

```
##   Year Site    effort
## 1 2013    2 0.2536111
## 2 2013    4 0.2930556
## 3 2013    6 0.2122222
## 4 2013    8 0.2325000
## 5 2013   10 0.2430556
## 6 2013   15 0.2811111
## 7 2013   18 0.3077778
## 8 2013   19 0.3097222
```

```
## [1] "2013 Sites"
```

```
## [1]  2  4  6  8 10 15 18 19
```

```
## [1] "Sites 11 & 12 are Missing"
```

I will need to throw out fish from sites 11 and 12 during 2013.

```
##     Site FID Weight Length Sex
## 195   11   4    160    224   2
## 197   11   3    273    266   2
## 198   11   7    316    273   2
## 200   11   6    350    318   2
## 201   11   2    604    348   2
## 204   11   1    968    395   1
## 205   11   8   1159    426   1
```

```
## [1] "No largemouth bass from site 12"
```

```
## [1] "Number of largemouth bass in site 11"
```

```
## [1] 7
```

This will remove 7 LMB from Site 11 in 2013. *Also, there is no effort data for 2017*

Sum Fish of each Species Caught by Year and Site

```
bio <- bio1 %>% group_by(Year, Site, Species) %>% summarize(caught = sum(Count)) %>%
    as.data.frame()
```

```
headtail(bio, n=2)
```

```
##     Year Site Species caught
## 1   2013    2     302      1
## 2   2013    2     313      1
## 130 2016   18     314     16
## 131 2016   18     317     51
```

```
headtail(eff, n=2)
```

```
##    Year Site    effort
## 1  2013    2 0.2536111
## 2  2013    4 0.2930556
## 41 2016   18 0.3444444
## 42 2016   19 0.2322222
```

Note:

It looks like I have effort data for site 19 from 2016 and 2013 but no fish. It must be that only non sport fish were caugth at site 19 so there is no length data. Add Zeros later in document.

2013

```
## [1]  2  4  6  8 10 15 18
```

```
## [1]  2  4  6  8 10 15 18 19
```

2014

```
##  [1]  1  2  4  6  8 10 11 12 15 16 18 19
```

```
##  [1]  1  2  4  6  8 10 11 12 15 16 18 19
```

2015

```
##  [1]  2  4  5  6  8 11 12 15 18 19
```

```
##  [1]  2  4  5  6  8 11 12 15 18 19
```

2016

```
##  [1]  2  4  6  8 10 11 12 13 14 15 18
```

```
##  [1]  2  4  6  8 10 11 12 13 14 15 18 19
```

Join Bio and Effort Data

```
catch <- left_join(eff, bio, by = c("Year", "Site")) %>% as.data.frame()

headtail(catch)
```

```
##     Year Site    effort Species caught
## 1   2013    2 0.2536111     302      1
## 2   2013    2 0.2536111     313      1
## 3   2013    2 0.2536111     314     25
## 131 2016   18 0.3444444     314     16
## 132 2016   18 0.3444444     317     51
## 133 2016   19 0.2322222      NA     NA
```

```
str(catch)  # Needs to be data frame
```

```
## 'data.frame':    133 obs. of  5 variables:
##  $ Year   : int  2013 2013 2013 2013 2013 2013 2013 2013 2013 2013 ...
##  $ Site   : int  2 2 2 2 2 2 4 4 4 4 ...
##  $ effort : num  0.254 0.254 0.254 0.254 0.254 ...
##  $ Species: int  302 313 314 316 317 702 41 302 313 314 ...
##  $ caught : int  1 1 25 1 22 2 1 1 1 7 ...
```

Add Zeroes for Species Not Observed in a Site

```
catch %<>% addZeroCatch("Site", "Species", zerovar = "caught") %>% arrange(Year,
    Site)

headtail(catch)  ### Here are the zeroes for site 19 2013 and 2016 problem resolved
```

```
##     Year Site    effort Species caught
## 1   2013    2 0.2536111     302      1
## 2   2013    2 0.2536111     313      1
## 3   2013    2 0.2536111     314     25
## 584 2016   19 0.2322222     342      0
## 585 2016   19 0.2322222     702      0
## 586 2016   19 0.2322222     705      0
```

Make CPUE Variable (Catch/Houre of Electrofishing)

```
catch %<>% mutate(cpe.hr = caught/effort)

headtail(catch, n = 2)
```

```
##     Year Site    effort Species caught   cpe.hr
## 1   2013    2 0.2536111     302      1 3.943045
## 2   2013    2 0.2536111     313      1 3.943045
## 585 2016   19 0.2322222     702      0 0.000000
## 586 2016   19 0.2322222     705      0 0.000000
```

```
# 2-7-2018#write.csv(catch,'Data/Clean-Data/CPUE_2013-2016.csv',row.names =
# FALSE)
```

Summarize CPUE by Year for Each Species

```
cpeSum <- catch %>% group_by(Year, Species) %>% summarize(samples = n(), fish = sum(caught),
    mean = mean(cpe.hr), sd = sd(cpe.hr), se = sd/sqrt(samples), RSE = se/mean *
        100) %>% as.data.frame()

cpeSum[cpeSum$Species == 317 | cpeSum$Species == 314 | cpeSum$Species == 316,
    ]
```

```
##    Year Species samples fish      mean        sd        se      RSE
## 6  2013     314       7  127 71.857270 75.210296 28.426820 39.56012
## 7  2013     316       5    6  4.345921  7.705099  3.445825 79.28871
## 8  2013     317       8  107 48.505090 38.186014 13.500795 27.83377
## 22 2014     314      10  105 34.548171 38.575935 12.198782 35.30949
## 23 2014     316       9   17  4.722013  6.852968  2.284323 48.37603
## 24 2014     317      12  143 42.056226 32.010396  9.240605 21.97203
## 38 2015     314       8   58 30.482297 55.930684 19.774483 64.87202
## 39 2015     316       9   14  5.883621  8.749873  2.916624 49.57193
## 40 2015     317      10   80 32.457388 34.794091 11.002858 33.89939
## 54 2016     314       9   85 36.123237 79.141656 26.380552 73.02931
## 55 2016     316       9    5  1.699203  3.068929  1.022976 60.20331
## 56 2016     317      12  144 44.608813 56.343683 16.265020 36.46145
```

```
# 2-7-2018#write.csv(cpeSum,'Data/Clean-Data/summary-data/cpeSum.csv',row.names
# = FALSE)
```

CPUE by Gabelhouse Length Category

1) First, I will make new data object (bio2) and add species names (Sp.Names) character variable. This way I can conviniently sort each species of fish into its correct Gabelhouse length category based on its length.
2) Second, I'll remove species that do not have Gabelhouse length categories (Hybrids & non-sport fish) as well as sites 11 and 12 from 2013 as before.
3) I will add zeroes for all species and gcat (of each species) for every site and year. Check that I made the data corectly and make an output .csv

Make New Biodat with Gabelhouse Length Categories Assigned to Species

```
headtail(bio1)
```

```
##         PROJCODE Species Year Site FID Weight Length AC Age SexCon Sex
## 1    NS2013.02.3     314 2013    2  NA     NA     74  3  NA     NA  NA
## 2    NS2013.02.4     314 2013    2  NA     NA     95  3  NA      1   1
## 3    NS2013.02.1     314 2013    2  NA     NA    103  3  NA     NA  NA
## 1098   NS2016.18     317 2016   18  11   1131    409  3   4      8   2
## 1099   NS2016.18     317 2016   18  10   1258    423  3   8      8   2
## 1100   NS2016.18     317 2016   18  24   1312    431  3   6      8   2
##      Count
## 1        1
## 2        1
## 3        1
## 1098     1
## 1099     1
## 1100     1
```

```
bio2 <- bio1

bio2$Sp.Name <- numeric(nrow(bio2))
headtail(bio2)
```

```
##         PROJCODE Species Year Site FID Weight Length AC Age SexCon Sex
## 1    NS2013.02.3     314 2013    2  NA     NA     74  3  NA     NA  NA
## 2    NS2013.02.4     314 2013    2  NA     NA     95  3  NA      1   1
## 3    NS2013.02.1     314 2013    2  NA     NA    103  3  NA     NA  NA
## 1098   NS2016.18     317 2016   18  11   1131    409  3   4      8   2
## 1099   NS2016.18     317 2016   18  10   1258    423  3   8      8   2
## 1100   NS2016.18     317 2016   18  24   1312    431  3   6      8   2
##      Count Sp.Name
## 1        1       0
## 2        1       0
## 3        1       0
## 1098     1       0
## 1099     1       0
## 1100     1       0
```

```
for (i in 1:nrow(bio2)) {
    if (bio2$Species[i] == 41) {
        bio2$Sp.Name[i] = "Longnose Gar"
    } else if (bio2$Species[i] == 171) {
        bio2$Sp.Name[i] = "Shorthead Redhorse"
    } else if (bio2$Species[i] == 201) {
        bio2$Sp.Name[i] = "Spottail Shiner"
    } else if (bio2$Species[i] == 203) {
        bio2$Sp.Name[i] = "Spotfin Shiner"
    } else if (bio2$Species[i] == 301) {
        bio2$Sp.Name[i] = "White Perch"
    } else if (bio2$Species[i] == 302) {
        bio2$Sp.Name[i] = "White Bass"
    } else if (bio2$Species[i] == 311) {
        bio2$Sp.Name[i] = "Rock Bass"
    } else if (bio2$Species[i] == 312) {
        bio2$Sp.Name[i] = "Green Sunfish"
    } else if (bio2$Species[i] == 313) {
        bio2$Sp.Name[i] = "Pumpkinseed"
    } else if (bio2$Species[i] == 314) {
        bio2$Sp.Name[i] = "Bluegill"
    } else if (bio2$Species[i] == 316) {
        bio2$Sp.Name[i] = "Smallmouth Bass"
    } else if (bio2$Species[i] == 317) {
        bio2$Sp.Name[i] = "Largemouth Bass"
    } else if (bio2$Species[i] == 319) {
        bio2$Sp.Name[i] = "Black Crappie"
    } else if (bio2$Species[i] == 324) {
        bio2$Sp.Name[i] = "Orangespotted Sunfish"
    } else if (bio2$Species[i] == 331) {
        bio2$Sp.Name[i] = "Yellow Perch"
    } else if (bio2$Species[i] == 334) {
        bio2$Sp.Name[i] = "Walleye"
    } else if (bio2$Species[i] == 342) {
        bio2$Sp.Name[i] = "Logperch"
    } else if (bio2$Species[i] == 702) {
        bio2$Sp.Name[i] = "Pumpkinseed Bluegill Hybrid"
    } else {
        bio2$Sp.Name[i] = "Green Sunfish Bluegill Hybrid"
    }
}
bio2 %<>% mutate(lcat20 = lencat(Length, w = 20)) %>% mutate(lcat10 = lencat(Length,
    w = 10)) %>% mutate(gcat = psdAdd(Length, Sp.Name))
```

```
## No known Gabelhouse (PSD) lengths for Green Sunfish Bluegill Hybrid

## No known Gabelhouse (PSD) lengths for Logperch

## No known Gabelhouse (PSD) lengths for Orangespotted Sunfish

## No known Gabelhouse (PSD) lengths for Pumpkinseed Bluegill Hybrid

## No known Gabelhouse (PSD) lengths for Spotfin Shiner

## No known Gabelhouse (PSD) lengths for Spottail Shiner
```

```
gcat.bio <- bio2 %>% group_by(Year, Site, Species, gcat) %>% summarize(caught = sum(Count)) %>%
    as.data.frame()

headtail(gcat.bio, n = 2)
```

```
##     Year Site Species      gcat caught
## 1   2013    2     302     stock      1
## 2   2013    2     313   quality      1
## 265 2016   18     317   quality     19
## 266 2016   18     317 preferred     10
```

```
str(gcat.bio)
```

```
## 'data.frame':    266 obs. of  5 variables:
##  $ Year   : int  2013 2013 2013 2013 2013 2013 2013 2013 2013 2013 ...
##  $ Site   : int  2 2 2 2 2 2 2 2 2 2 ...
##  $ Species: int  302 313 314 314 314 316 317 317 317 702 ...
##  $ gcat   : Factor w/ 6 levels "substock","stock",..: 2 3 1 2 3 1 1 2 3 NA ...
##  $ caught : int  1 1 1 16 8 1 9 7 6 2 ...
```

Note: *No Gabelhouse length category data for Green Sunfish Bluegill Hybrid, Logperch, Orangespotted Sunfish, Pumpkinsee Bluegill Hybrid, Spotfin Shiner, Spottail Shiner. This seems obvious but is good to take note of. Im going to go back and remove those species*

Remove Unwanted Data

See Source

Merge Effort and Bio Data

```
headtail(eff)
```

```
cpe <- left_join(eff, gcat.bio, by = c("Year", "Site")) %>% as.data.frame()

headtail(cpe)
```

```
##     Year Site    effort Species      gcat caught
## 1   2013    2 0.2536111     302     stock      1
## 2   2013    2 0.2536111     313   quality      1
## 3   2013    2 0.2536111     314  substock      1
## 241 2016   18 0.3444444     317   quality     19
## 242 2016   18 0.3444444     317 preferred     10
## 243 2016   19 0.2322222      NA      <NA>     NA
```

```
str(cpe)
```

```
## 'data.frame':    243 obs. of  6 variables:
##  $ Year   : int  2013 2013 2013 2013 2013 2013 2013 2013 2013 2013 ...
##  $ Site   : int  2 2 2 2 2 2 2 2 2 4 ...
##  $ effort : num  0.254 0.254 0.254 0.254 0.254 ...
##  $ Species: int  302 313 314 314 314 316 317 317 317 41 ...
##  $ gcat   : Factor w/ 6 levels "substock","stock",..: 2 3 1 2 3 1 1 2 3 1 ...
##  $ caught : int  1 1 1 16 8 1 9 7 6 1 ...
```

Add Zeroes for Each Species and Gabelhouse Length Category

```
# cpe$ID <- paste(cpe$Year,'.',cpe$Site)

cpe %<>% addZeroCatch("Site", "Species", zerovar = "caught") %>% # cpe %<>% addZeroCatch('ID','Species'
arrange(Year, Site)  ### add zeroes for species

cpe$ID <- paste(cpe$Year, ".", cpe$Site, ",", cpe$Species)  ### create new ID variable

cpe %<>% addZeroCatch("ID", "gcat", zerovar = "caught") %>% arrange(Year, Site)
## add zeroes for all empty gcats for each species at each site for every
## year

cpe %<>% dplyr::select(Year:caught)  ### remove the ID variable created above
```

Check if I Need to Remove Any Sites from a Particular Year

2013

```
Remove.Sites$rm.13
```

```
## [1]  1  5 11 12 13 14 16
```

```
tmp.13 <- cpe[cpe$Year == 2013, ]
unique(tmp.13$Site)
```

```
## [1]  2  4  6  8 10 15 18 19
```

2014

```
Remove.Sites$rm.14
```

```
## [1]  5 13 14
```

```
tmp.14 <- cpe[cpe$Year == 2014, ]
unique(tmp.14$Site)
```

```
##  [1]  1  2  4  6  8 10 11 12 15 16 18 19
```

2015

```
Remove.Sites$rm.15
```

```
## [1]  1 10 13 14 16
```

```
tmp.15 <- cpe[cpe$Year == 2015, ]
unique(tmp.15$Site)
```

```
##  [1]  2  4  5  6  8 11 12 15 18 19
```

2016

```
Remove.Sites$rm.16
```

```
## [1]  1  5 16
```

```
tmp.16 <- cpe[cpe$Year == 2016, ]
unique(tmp.16$Site)
```

```
##  [1]  2  4  6  8 10 11 12 13 14 15 18 19
```

```
### I guess im good then
```

Check All Zeroes are Present

```
xtabs(caught ~ Species + gcat + Year, data = cpe)
```

```
## , , Year = 2013
##
##        gcat
## Species substock stock quality preferred memorable trophy
##     302        0     4       0         0         0      0
##     311        0     0       0         0         0      0
##     312        0     0       0         0         0      0
##     313        0    10       5         0         0      0
##     314        5    81      40         1         0      0
##     316        1     3       2         0         0      0
##     317       16    38      39        14         0      0
##     319        0     0       0         0         1      0
##     331        2     1       0         0         0      0
##     334        0     0       0         0         0      0
##     41         1     0       0         0         0      0
##
## , , Year = 2014
##
##        gcat
## Species substock stock quality preferred memorable trophy
##     302        0     1       0         0         0      0
##     311        3     5       5         1         0      0
##     312        0     1       0         0         0      0
##     313        1    16      11         0         0      0
##     314       12    49      43         1         0      0
##     316        4     1       6         6         0      0
##     317        3    65      57        18         0      0
##     319        0     0       1         0         0      0
##     331       14     8       4         0         2      0
##     334        0     0       0         0         1      0
##     41         0     2       0         0         0      0
##
## , , Year = 2015
##
##        gcat
## Species substock stock quality preferred memorable trophy
##     302        0     0       0         0         0      0
##     311        8     2       1         0         0      0
##     312        0     2       0         0         0      0
##     313        2    14       1         0         0      0
##     314        1    30      23         3         0      1
##     316        5     5       3         1         0      0
##     317       13    14      38        15         0      0
##     319        1     0       0         0         0      0
##     331        4     2       1         0         0      0
##     334        2     0       0         0         0      0
##     41         0     0       0         0         0      0
```

```
##
## , , Year = 2016
##
##         gcat
## Species substock stock quality preferred memorable trophy
##     302        0     0       0         0         0      0
##     311        0     0       0         0         0      0
##     312        0     0       0         0         0      0
##     313        0     0       0         0         0      0
##     314        4    73       7         1         0      0
##     316        0     2       1         1         1      0
##     317       34    53      47        10         0      0
##     319        0     0       0         0         0      0
##     331        0     0       0         0         0      0
##     334        0     0       0         0         0      0
##     41         0     0       0         0         0      0
```

Make CPUE Variable

```
cpe %<>% mutate(cpe.hr = caught/effort)
```

Save Data File

Summarize CPUE by Site and Gcat

```
cpeSum.gcat <- cpe %>% group_by(Year, Species, gcat) %>% summarize(samples = n(),
    fish = sum(caught), mean = mean(cpe.hr), sd = sd(cpe.hr), se = sd/sqrt(samples),
    RSE = se/mean * 100) %>% as.data.frame()

# 2-9-2018#write.csv(cpeSum.gcat,'Data/Clean-Data/summary-data/cpeSum_gcat.csv',row.names
# = FALSE)
```

```
##  Year Species      gcat samples fish      mean mean.1     sd    se     RSE
##  2013     317     stock       8   38 17.527035 17.527 11.054 3.908  22.298
##  2014     317     stock      12   65 19.249018 19.249 22.371 6.458  33.550
##  2015     317     stock      10   14  5.650490  5.650 10.021 3.169  56.081
##  2016     317     stock      12   53 17.013989 17.014 18.763 5.417  31.836
##  2013     317   quality       8   39 17.259044 17.259 16.422 5.806  33.640
##  2014     317   quality      12   57 16.879829 16.880 10.812 3.121  18.490
##  2015     317   quality      10   38 15.024400 15.024 17.079 5.401  35.947
##  2016     317   quality      12   47 14.509571 14.510 15.632 4.513  31.101
##  2013     317 preferred       8   14  5.986703  5.987 10.157 3.591  59.985
##  2014     317 preferred      12   18  4.938368  4.938  3.671 1.060  21.457
##  2015     317 preferred      10   15  6.201574  6.202  6.308 1.995  32.168
##  2016     317 preferred      12   10  2.419355  2.419  8.381 2.419 100.000
```

Interesting CPE for quality and Preferred fish may be decreasing.